Sterigenics

Irradiation of Produce Imports

Small Inroads, Big Obstacles

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- Fruit and vegetable imports to the U.S. have been growing, but fumigation, the main treatment for quarantine pests on fruit and vegetables, faces an uncertain regulatory climate.
- Irradiation can act as an alternative treatment for foodborne pests, but it requires labeling and large investments in facilities.
- Though some consumers remain wary of the process, irradiated specialty products have gained a market foothold where few alternative treatments are available.

Since the 1980s, the produce trade has expanded and become more diverse, both in the variety and sources of fruit and vegetables. Per capita U.S. consumption of fruit and vegetables has increased, with a larger share of fresh produce available to consumers and more of it being imported. But, access to U.S. fresh markets is barred for goods with pest problems unless a treatment or other measure can mitigate the risk.


FDA

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Currently, three principal treatment methods are used on fruit and vegetables imported into the United States: mechanical (such as cold treatment or hot water or chemical dips), fumigation, and irradiation. While irradiation has certain advantages over the other methods, its use has been limited by high costs and poor consumer acceptance. For some imports of tropical fruit and vegetables, where alternative treatments are infeasible, importers are using irradiation to access U.S. markets. And ongoing environmental concerns about methyl bromide as a fumigant could lead importers to reconsider irradiation as a way to maintain market access.

Most Imports Carry Small Pest Risks, But a Few Require More Attention

Before fruit and vegetable imports can gain access to the U.S. market, they undergo a pest-risk assessment. USDA's Animal and Plant Health Inspection Service (APHIS) catalogues the pests associated with a commodity, assesses the pests' risks and interactions in the environment, and tests treatment options. No import is risk free, but regulators may recommend that a commodity be allowed to enter if treatments or other phytosanitary measures can reduce pest risks to acceptable levels. Fruit and vegetable imports are inspected at the border to confirm that imports meet specified phytosanitary requirements. Inspections check for host-specific pests, which require the commodity to live or reproduce, and "hitchhiker" pests, which do not.

Some commodities carry more pests and some pests are worse than others. No treatment for fungal, viral, and bacterial pests, such as potato wart, banana bunchy top, and citrus canker, can be undertaken at the border. When severe pests like these are discovered in an exporting country, the goods are typically not permitted entry to the U.S. Some pests, such as meal worms or cockroaches, are already endemic to the U.S. and are not considered "actionable" in a way that restricts trade.

Most insect pests are actionable but treatable. If an inspection finds these pests, a spot treatment is required. If repeated inspections of a specific good from a specific country continually find these pests, then the treatment may become mandatory. In 2001, for example, regulators ordered that all asparagus from Peru be fumigated because inspectors repeatedly discovered

Imports help meet rising U.S. demand for fresh fruit and vegetables

	Per U.S. capita consumption of fruit and vegetables	Preserved (frozen, dried, canned) share	Fresh share	Imports share of fresh
	Pounds	*Percent*		
1980-89	91.1	26.9	73.1	7.6
2005-09	100.7	21.1	78.9	30.4

Source: USDA, Economic Research Service using data from USDA, Agricultural Marketing Service.

the eggs of a potentially invasive moth in shipments for export.

Available Pest Treatments Have Disadvantages

All treatments—mechanical, fumigation, and irradiation—raise costs of importation. They can also cause subtle damage to the commodities treated, with the effects varying by treatment and commodity.

Mechanical treatments include cold temperature treatments, hot water or chemical dips, shaking, or washing the commodity. For example, Spanish citrus is cold-treated for at least 14 days during shipment to the U.S., with only minor losses of value. Each mechanical treatment must be retested for every new pest or commodity, and minor variations in traits, like the skin thickness of a melon or the heat tolerance of mangoes, may change the effectiveness of or damage from a treatment. Furthermore, these treatments cannot typically be applied as a spot treatment at the border if a hitchhiker pest is found.

Fumigation using methyl bromide kills insects through inhalation of gas and, in most cases, has few effects on a commodity's quality. The treatment takes several hours but requires no special facilities or capital investment. For this reason, it can also be used both as a spot treatment for hitchhikers or as a regular mandatory treatment for chronic pests. Fumigation, however, is ineffective for certain burrowing insects that do not breath the gas and that are common on tropical fruit.

While not dangerous to consumers, methyl bromide can harm the health of its handlers. More significantly, methyl bromide depletes the ozone layer. The Montreal Protocol on Substances That Deplete the Ozone Layer curtails its current use, and other international organizations have also called for reductions in its use.

Irradiation imparts radiant energy to disrupt cellular activity. High doses of irradiation associated with food safety uses will kill insects and other pathogens, such as *E. coli* O157:H7 on ground beef. Low doses of irradiation uses for quarantine purposes on fresh produce need only sterilize insects. Because radiation penetrates through the fruit or vegetable, burrowing insects can be treated with relatively little damage to the commodity. The process is quick but requires specialized packaging and movement of goods to ensure the correct dosage is reached and to prevent hitchhiker pests from later moving into packages that have been irradiated, as these pests are otherwise indistinguishable from sterilized ones. Currently, irradiation cannot be used for spot treatments, and adapting irradiation for this purpose would require substantial changes to the logistics of produce packaging and movement.

Overcoming Barriers, Irradiation Makes Small Inroads

Despite a wide range of approved uses, including food preservation and safety, food irradiation is limited and controversial. Research suggests that consumers will pay more for irradiated food if they believe it is safer, but they remain sensitive to claims suggesting that irradiated food is unhealthy or harmful, regardless of the source or credibility of the information.

One popular misconception is that irradiation may make the food radioactive; this is untrue.

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As of mid-2011, less than one-tenth of 1 percent of fruit, vegetables, and meats imported by the U.S. is irradiated.

One popular misconception is that irradiation may make the food radioactive; this is untrue. Detractors of the treatment also claim that it reduces the content of some vitamins in food and releases harmful byproducts. When the U.S. Food and Drug Administration (FDA) has evaluated the irradiation of foods, it has consistently concluded that the vitamin loss is not relevant when compared with the total dietary intake of vitamins and that the byproducts produced are no different than those produced from cooking food. FDA requires that food products that have been irradiated display the *radura* label. Consumer perceptions of irradiated products remain largely negative, and offerings of such foods are limited, despite regulatory approvals since 1986 for spices, fruit, and vegetables; 1990 for poultry products; and 1997 for most meats. The FDA is considering proposals that would change the labeling requirement (currently, all irradiated foods must state that the food is "treated with radiation" or "treated by irradiation"). New labels may include supplemental information such as "treated with radiation to control spoilage," "treated with radiation to extend shelf life," or "treated with radiation to inhibit maturation."

As of 2010, less than one-tenth of 1 percent of fruit, vegetables, and meats imported by the U.S. is irradiated. The process has made the most significant inroads with spices—about a third of domestically consumed spices are irradiated to eliminate pathogens. The process of harvesting and drying spices, often done in countries with a poor food safety infrastructure, can introduce potential pathogens to foods in which they are used.

Most retail spices are not irradiated but are treated instead with ethylene oxide, a hazardous and flammable gas. Prepared foods that incorporate irradiated spices do not require the radura logo, and spice manufacturers are petitioning the FDA to eliminate the labeling requirement on retail products.

Irradiation causes less damage to fruit and vegetables than older/more traditional techniques. But, irradiation is more expensive than fumigation as a pest treatment. Unlike fumigation, irradiation requires specialized facilities, packaging, and technical expertise, making it subject to economies of scale. Processing larger amounts can spread irradiation's high fixed cost over larger volumes of goods, thereby reducing its average cost. In most cases, neither irradiation nor fumigation is prohibitively costly relative to the value of the product. Estimates suggest that an irradiation treatment of peaches, apples, plums, or cherries might cost two to three times that of fumigation, which costs around 1 cent per pound. However, because irradiation has not been widely adopted, some irradiation equipment is under-utilized at current capacity levels, as throughput has been low and seasonal. Under-utilization translates into a higher average cost for providing irradiation services. But if markets for irradiation service are not large enough to support multiple firms, operators may lack competitors and gain market power allowing them to price above their average cost.

Some Recent Trends Favor Irradiation

In recent years, four regulatory shifts have made irradiation more tenable as a quarantine treatment. First, in 2006, APHIS decided that irradiation could be used as a "generic" quarantine treatment for all insect pests, excluding moths in certain life stages. Previously, importers

faced considerable uncertainty and delay as regulators had to test the effectiveness of irradiation on each specific pest that could prevent a commodity's importation. The 2006 APHIS decision resulted in a significantly streamlined process. Now, only verification that a minimum irradiation dosage has penetrated the commodity is required to ensure the treatment's effectiveness.

Second, in 2007, APHIS adopted a "notification-based" regulatory process that streamlined the regulatory process for allowing importation of new fruit and vegetables if the goods meet some basic risk mitigation criteria. APHIS estimates that the new process will reduce the time required for new goods to be permitted import entry from 2 to 3 years to a few months.

Third, in 2010, APHIS allowed mangoes from Pakistan to be irradiated domestically rather than at a foreign facility prior to shipment, making it possible to spread the high fixed costs of the treatment over a larger volume of goods at irradiation hubs. Similarly, an additional irradiation facility is being constructed in Mexico, which may further reduce costs, as the size and diversity of fruit and vegetables from Mexico has grown with the adoption of the North American Free Trade Agreement.

Finally, international pressure to curtail the use of ozone-depleting methyl bromide continues. Adopted in 1993, the Montreal Protocol restricts use of methyl bromide. Since 2005, only two uses have been permitted in developed countries: critical uses, such as soil sterilization, and quarantine and pre-shipment (QPS) uses, including border fumigations.

The Montreal Protocol required that critical uses be phased out. Thus, while U.S. methyl bromide use in 2008 was less than a third of its 1991 level, most of the decline was in critical uses. QPS uses represented over a third of total U.S. methyl bromide use in 2008.

Fresh guava from Mexico is the most significant irradiated produce import.

In 2010, the European Union prohibited all use of the gas within its borders. While there are no explicit cost mechanisms to encourage importers to use alternatives to methyl bromide, importers of products that require mandatory treatments as a condition of entry into the U.S., such as asparagus from Peru, remain concerned about the regulatory future of methyl bromide.

Use of Irradiation Growing for Imports of Specialty Ethnic Produce

Several supply-side factors, such as trade liberalization, logistical improvements in shipping and refrigeration, and reduced regulatory obstacles, have raised the potential for increased use of irradiation on imported food. Demand-side

Future irradiated fruit imports may be specialty crops popular in ethnic food markets

Goods being considered for importation with an irradiation treatment

Country	Commodities
Australia	Litchi, mango
Central and/or South America	Guava
East Africa	Passionfruit
Economic Community Of West African States	Mango, papaya
Hawaii	Guava
India	Pomegranate, grape
Madagascar	Litchi
Malaysia	Papaya, pineapple, starfruit
Mexico	Mango, citrus
Philippines and Vietnam	Litchi, longan, rambutan
South Africa	Persimmon, litchi, stonefruit
Spain	Apricot
Taiwan	Guava
Thailand	Cucurbit, guava
Turkey	Black fig, pomegranate

Source: USDA, Economic Research Service using data from USDA, Animal and Plant Health Inspection Service.

Fresh guava from Mexico leads U.S. imports of irradiated produce

Import	Condition	Origin	2005	2006	2007	2008	2009	2010
			Metric tons					
Guava	Fresh	Mexico	-	13	-	253	3,115	4,499
		Others	-	-	-	-	-	-
	Frozen	Mexico	1,148	1,054	1,221	1,073	774	858
		Others	21	1	221	46	16	16
Longan	Fresh	Thailand	-	-	123	1,646	1,576	963
		Others	633	1,438	1,272	865	179	196
	Frozen	Thailand	76	-	37	43	11	22
		Others	33	16	22	44	-	-
Rambutan	Fresh	Thailand	-	-	-	19	18	19
		Others	203	146	263	319	856	992
	Frozen	Thailand	1	2	3	3	11	10
		Others	2	-	14	-	-	1
Mango	Fresh	India	-	-	133	189	91	79
		Others (x 1,000)	269	259	329	302	310	327
	Frozen	India	-	-	-	20	18	63
		Others (x 1,000)	11	16	20	28	21	32
Mangosteen	Fresh	Thailand	-	-	-	330	388	447
		Others	-	-	-	-	-	-
	Frozen	Thailand	30	-	43	13	11	6
		Others	26	-	-	22	26	26
Dragon fruit	Fresh	Thailand	-	-	-	137	116	585
		Others	-	-	-	-	-	1
	Frozen	Thailand	-	-	-	-	3	-
		Others	1	-	-	-	-	-

Shaded areas denote that the importation of irradiated products is permitted.

- denotes zero imports.

Source: USDA, Economic Research Service using data from USDA, Animal and Plant Health Inspection Service's Plant Protection and Quarantine Form 280.

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factors also play a large role. As incomes have risen, consumers' diets have shifted steadily to include fresher and more diverse foods, especially fruit and vegetables. Rising Latino and Asian immigrant populations in the U.S. also represent a ready market for some specialty produce imported from their native countries, and these consumers often pay large markups for preferred varieties.

Fresh guava from Mexico is the most significant irradiated produce import. U.S. guava production fell from a peak of 12,000 tons in 1990 (much of it from Hawaii and destined for processing uses) to around 1,000 tons in 2009. In 2010, fresh imports of Mexican guava approached 4,500 tons, accounting for nearly all fresh imports of the product.

Other irradiated specialty crops have also established small footholds. Irradiated dragon fruit (pitahaya) from Vietnam and rhambutan and mangosteens from Thailand make up 100 percent of fresh imports of those commodities by the U.S. Irradiated longans from Thailand, which compete with cold-treated Chinese imports, also account for over half the market for that product.

For more mainstream commodities, such as Thai pineapple and Mexican mangoes, irradiated goods represent a very small share of the total market. Indian mangoes have been available in the U.S. since 2007, but their share of the import market has never exceeded 1 percent. In 2010, APHIS was considering 27 types of irradiated produce for import access to the United States, many for specialty products sold in ethnic markets.

Irradiation is an expensive treatment option that carries a certain stigma. In cases in which access to the U.S. market is otherwise infeasible, importers may be compensated for the costs of irradiation due to a lack of competitive substitutes for their products. It is uncertain if the stigma associated with irradiation will fade as scale economies lower costs and consumers become more comfortable with the technology. Irradiation's use is most common for ethnic foods for which the affinity between food and culture is strong, and import access for these particular foods is otherwise unattainable.

This article is drawn from . . .

"Irradiation as a Quarantine Treatment," by Peyton Ferrier, in *Food Policy* 35(2010)548-555.

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